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ABSTRACT

This report describes the PLATO integration strategies used by Mashpee High School in Mashpee, MA to improve student performance on the Massachusetts Comprehensive Assessment System (MCAS) test, the state's skill exam. The MCAS test covers two areas, mathematics and English, and is tied to high school graduation. Mashpee High School's efforts and the focus of this report are on improving student math scores. Mashpee High School used PLATO to: (1) match students' PLATO curriculum to target objectives covered in the MCAS; (2) align the curriculum to the state standards; (3) provide individual remediation for academically at-risk students to pass the MCAS; and (4) provide individual assessment and tracking. This report evaluates the general effectiveness of the school's remediation strategies that included PLATO coursework, better alignment with state standards, staff development, improved delivery of traditional instruction, standards-based lesson planning, and helping at-risk students improve study and organizational skills. This report describes the manner in which the PLATO was used at Mashpee High School and examines the effectiveness of the MCAS remediation effort. (Author/KHR)

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Evaluation Series

Mashpee High School, Mashpee, MA

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Executive Summary

Mashpee High School, Mashpee MA, a suburban school, has used PLATO from Fall 2000 to help under-performing students pass the state mandated competency exam, the Massachusetts Comprehensive Assessment System (MCAS) exam. Mashpee High School used PLATO in 2000-2001 exclusively to help students improve Math scores. There has been a strong commitment from the administration and faculty to customize instruction to align the curriculum to state standards covered on the MCAS exam. Mashpee uses a dedicated PLATO lab to help tenth graders identified as at risk of failing the MCAS exam

The purpose of this evaluation report is to describe the manner in which PLATO has been used at Mashpee High School and to examine the effectiveness of the MCAS remediation effort.

Some of the more important results of this evaluation include:

- MCAS math scale scores improved significantly for the 87 students who were identified as "at risk" of failing and enrolled in the Mashpee Fall 2000 PLATO remediation program. These students' scores improved from an average of 215.7 (passing level of 220) on the 1999 exam (when they were in 8th grade) to 236.1 on the 2001exam when they were sophomores, a difference significant at less than the .001 level and with an estimated effect size 1.27.
- The gain score of 20.4 points for these 87 "at risk' students was more dramatic (statistically) than the improvement of 11.2 points experienced by students not at risk, $p <$ .05, estimated effect size 1.27.
- A significant positive relationship was identified between student PLATO usage data (number of learning modules mastered) and their MCAS math scale scores, $r = .53$, $p <$ .001.
- The PLATO teacher-coordinator is quite positive about PLATO and believes that PLATO use directly contributed to student improvement on the MCAS scores. The district superintendent credits PLATO use as one of the five factors contributing to the gain.

Three Tables and two Figures are included that present MHS and state MCAS test results and PLATO data.

Introduction

This report describes the PLATO integration strategies used by Mashpee High School (MHS), Mashpee, MA to improve student performance on the Massachusetts Comprehensive Assessment System (MCAS) test, the state's skills exam. The MCAS test covers two areas, Math and English and will be tied to high school graduation in 2003. Mashpee High School's (MHS) efforts, and the focus of this report, were on improving student Math scores. This has been Mashpee's single-minded goal for using PLATO since they adopted it for this purpose in Fall 2000. They use PLATO to meet the following needs:

- Match student PLATO curriculum to target objectives covered in the MCAS
- Align the curriculum to the state standards
- Provide individual remediation for academically at-risk students to pass the MCAS
- Provide individual assessment and tracking

This report evaluates the general effectiveness of the school's remediation strategies which included: PLATO coursework, better alignment with state standards, staff development, improved delivery of traditional instruction, standards-based lesson planning, and helping at-risk students improve study and organizational skills. The purpose of this report is to describe the manner in which the PLATO was used at MHS and to examine the effectiveness of the MCAS remediation effort.

Program Description

Learners. Mashpee High School (MHS) serves a largely Caucasian, working middle class area on Cape Cod. Mashpee is a resort town with a large number of absent, second-home owners who live there only in the summers. There are approximately 987 students currently enrolled at MHS, 83 percent of whom are white, 7 % Native American, 6 % African American, and 3 % Hispanic students. Eleven percent of MHS students receive a free or reduced lunch from the federal lunch program. The average household income in Mashpee in 2000 was $32,624.

Program Goal. In 1999, MCAS Math scores for the MHS tenth graders had fallen to 15th among the 16 high schools on Cape Cod creating a sense of urgency to reverse this trend. MHS launched a comprehensive program to improve MCAS scores for at-risk students that included curriculum realignment, staff development, and standards-based planning and delivery of traditional instruction. In Fall 2000, the PLATO-based remediation Math course was added to strategy. This course was required of sophomores who were danger of failing the Math portion of the MCAS (to be taken May 2001). Students were classified as "at risk" based on their 8th grade MCAS scores. Rising sophomores whose 8th grade Math score were near or below the passing MCAS scale score of 220 were automatically enrolled in the remediation course in Fall 2000. This course, which met daily for 45 minutes per session, used PLATO to align the course content as closely as possible the competencies that were covered on the MCAS exam. This is the single unambiguous goal for PLATO use at MHS: to provide instruction to help struggling students pass the MCAS exam.

Mashpee's s proactive strategy to identify students early (based on eighth grade MCAS release test) is grounded in the belief that these students' best chance to pass the MCAS is on their *first* attempt. Once students have failed the MCAS in their sophomore year, they tend to

lose motivation making successful remediation in the junior and senior years more difficult. MHS also used PLATO for ninth grade students in the Spring semester, but that was not examined in this report.

Program Implementation Description. Mr. Rob Miceli in consultation with the MHS Math faculty developed a 34-module MCAS-aligned PLATO curriculum[1] that all students worked through. All tenth graders who scored marginally or failed the Math section of the 8th grade MCAS exam were enrolled in this highly targeted course. Students worked on the PLATO curriculum four days a week and worked on study skills, organizational, and test-taking skills on the fifth day. During the classes, there were opportunities for one-on-one help from Mr. Miceli, who is a certified teacher. There were also parent and community volunteers who worked as needed in the lab to assist high-need students. The management of the remediation effort required the full time efforts of a PLATO teacher-coordinator, whose task it was to monitor student progress through the course and assign course grades. Course grades were assigned based on the number of PLATO modules completed and several other criteria such as participation and attendance.[2]

Instructor Characteristics and Role in Program. Mr. Rob Miceli is the PLATO teacher-coordinator. He teaches the course, monitors student progress in the PLATO modules and follows up with students who need additional assistance.

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[1] Instructional features of the PLATO curricula are described in Foshay, R. (1998), *Instructional Philosophy and Strategic Direction of the PLATO System*. PLATO Technical Paper #3. Bloomington, MN: PLATO Learning, Inc. *-ed.*

[2] This is an example of the *skill building instructional model* more fully described in Foshay, R. (2000), *Instructional Models: Four Ways to Integrate PLATO Into the Curriculum*. PLATO Technical Paper #6. Bloomington, MN: PLATO Learning, Inc. *-ed.*

Evaluation Design

The MCAS exam is the primary measure examined here. MCAS scale scores range from 200 – 280, with a passing threshold of 220. Beginning with the class of 2003, all Massachusetts high school graduates will be required to pass the MCAS in English and Math. The state classifies student MCAS performance into four categories:

- *Advanced* - for students who score 260 – 280
- *Proficient* - for students who score 240 – 259
- *Needs Improvement* - for students who score 220 – 239
- *Warning/Failing* - for students who score below 220.

The current evaluation examines MCAS scores and PLATO module-mastery data, and summarizes an interview with Mr. Rob Miceli. MCAS scores are examined to detect differences in student performance – the stated purpose of the PLATO course. PLATO data are examined to identify any relationships that may exist between PLATO use and student performance on the MCAS exam. For the academic year 2000-2001, Mr. Miceli provided PLATO and MCAS data for 189 tenth graders (99 enrolled in the Fall 2000 PLATO course, 90 were not). Of these 189 students, sixty-three were missing either 8th or 10th grade MCAS scores and were not considered in the present evaluation, reducing the total participants to 126 (87 enrolled in PLATO, 39 not). Recall that students were assigned to the PLATO course based on their 8th grade MCAS scores. The average 8th grade MCAS scale score of the 87 enrolled students was 215.7 (passing score 220), while the average score for the non-PLATO group was 234.2. Finally, MHS scores were compared to the overall state MCAS scores for the same years.

Data Analysis. In reporting the interview results, common main ideas were collapsed and summarized. Since MCAS gain scores (taken in 8th grade and repeated in 10th grade) were of primary interest here, a Repeated Measures analysis of variance was used, which tested whether observed gains are significant at the .05 alpha level [3], or were just due to random fluctuations. The Repeated Measures test also allowed for comparison between the two groups, PLATO and non-PLATO. In other words, it tested whether one group outperformed the other. In addition, effect sizes were estimated.

Also of interest here, is whether PLATO use, that is the number of modules students completed and mastered, was associated with student performance on the MCAS exam. Pearson Product Moment bivariate correlations were used to examine the relationship between PLATO use and 10th grade MCAS test scores to determine whether or not MCAS gains were likely associated with the PLATO intervention.

Procedures for data collection. Mr. Miceli provided both PLATO and MCAS data for all students. State MCAS data were available at the state web site, http://www.doe.mass.edu/mcas. I interviewed by telephone Mr. Rob Miceli, the PLATO teacher-coordinator. I used the PLATO site overview questions to structure the interviews, and then allowed the line of inquiry to be guided by Mr. Miceli's concerns and perspectives.

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[3] The .05 alpha level of significance is a widely accepted threshold for statistical tests; findings that exceed this threshold, i.e., < .05, are believed NOT to be a result of chance.

Results

The results are organized into three sections, *MCAS scores, PLATO data,* and *Interviews.* The MCAS Scores section examines the MCAS Math performance of all MHS tenth graders who took the test in both the 8th and 10th grades[4]. For analysis purposes, students were grouped into two categories; those who were enrolled in the PLATO course and those who were not. The PLATO Data section presents module mastery data for the students who used PLATO during Fall 2000, in preparation for taking the May 2001 MCAS exam. Correlations were calculated between students' PLATO module data and their MCAS scores. The Interviews section summarizes the interviews with the principal and the PLATO teacher-coordinator.

MCAS Scores

Overall student scores increased significantly from 8th grade to 10th grade, increasing from an average of 221.5 to 239.0, $F(1, 124) = 108.64$, $p < .001$ (see Table 1). Further, both treatment groups, PLATO and non-PLATO, enjoyed a significant increase[5] in MCAS performance from 8th to 10th grade. But of particular interest is the significant interaction, $F(1, 124) = 9.08$, $p = .003$, between the treatment groups and the scores recorded on each test date. As mentioned, student scores in both groups improved significantly, but the interaction reveals that the PLATO group's improvement (from $M = 215.5$ to $M = 236.1$, estimated effect size 1.27[6]) was more dramatic (statistically) than the improvement of the students in the non-PLATO group

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[4] Wilks' Lambda multivariate test was significant [$F(1, 124) = 108.6$, $p < .001$] which warranted further univariate tests.

[5] After the significant univariate effect was found, Tukey's Wholly Significant Differences post hoc test was applied to examine individual differences across groups. This test established that gain scores across groups larger than 5.68 were significant at the .05 level. Students in both PLATO and non-PLATO groups achieved gain scores that exceeded that threshold.

(M = 234.2 to M = 245.4). In other words, while it is true that the non-PLATO group average score (M = 245.4) represents a significant difference[7] over their at-risk PLATO classmates (M = 234.2), the interaction (graphically depicted in Figure 1) indicates that the PLATO group *outperformed* the non-PLATO group in terms of the MCAS *gain* scores from 8th grade to 10th grade (a gain of 20.4 vs. 11.2).

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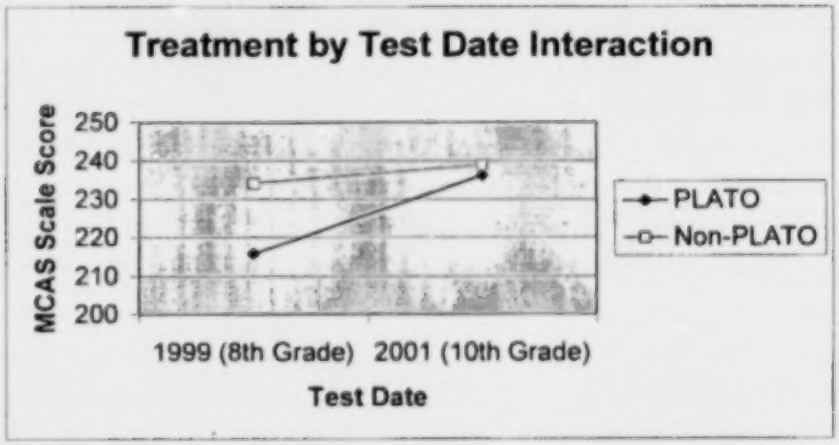
[6] Effect size is a measure of the gain scores relative to the amount of the variance. An effect size of .80 is generally considered to be large.
[7] See footnote 3. The same 5.68 threshold applies to differences between groups in the interaction effect.

Table 1. MCAS Math Scale Scores for 1999 (8th Grade) and 2001 (10th Grade) and PLATO Usage Data for Students at Mashpee High School

	Mean MCAS Scale Scores		
Students by Category	8th Grade 1999	10th Grade 2001	Gain Score
Students Enrolled in PLATO			
M	215.7	236.1	20.4
SD	9.8	16.1	NA
N = 87			
Students not Enrolled in PLATO			
M	234.2	245.4	11.2
SD	13.7	19.9	NA
N = 39			
Overall			
M	221.5	239.0	17.5
SD	14.0	17.8	NA
N = 126			

Note. Passing score is 220.

Figure 1. MCAS 2001 Scale Score Treatment by Test Date Interaction



The average 1998 – 2001 scale scores and percent passing rates for MHS 10th-grade students are compared to the overall state averages in Table 2 (and graphically displayed in Figure 2). Mashpee's improvement in scale scores in 2000 and 2001 is in line with the overall statewide trend, with Mashpee increasing from 219 in 1999 to 237[8] in 2001 while the overall state averages jumped from 222 to 237. As mentioned earlier, it was Mashpee's poor performance in 1999 when 60 percent of 10th graders failed the MCAS that prompted the adoption of new strategies to reverse the trend. And the pre-PLATO strategies employed in 1999-2000 (curriculum alignment with state standards, staff development, etc.) were in fact successful in bringing up scores from 219 to 229. When PLATO was added to the mix in 2000 - 2001, scores further improved from 229 to 237 (bearing in mind that not all MHS students used

[8] The discrepancy between this average scale score (237) and the average score calculated in the earlier analysis (239) is that the latter does not include all students; it only includes students for whom 8th and 10th grade scores were available. Of the 146 MHS students who took the exam (and are included in Table 2), 126 students were included in the earlier analysis.

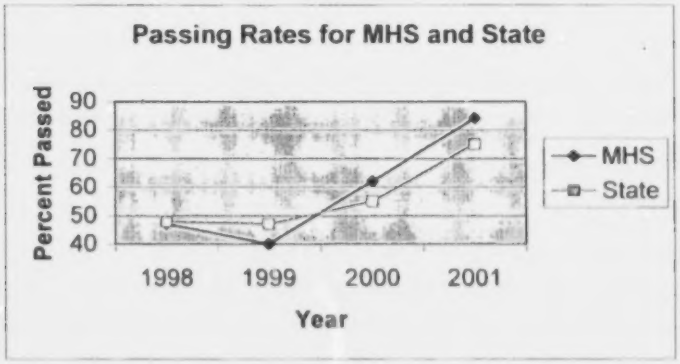
PLATO). Of particular interest (especially if you are a high school student or parent) are the passing rates. In 1999, only 40 percent of tenth graders passed the MCAS at MHS. The state average was not much better at 47 percent. In 2000, the passing rate improved to 62 percent at MHS compared to 55 percent in the state and in 2001, when PLATO was added, the number of students passing increased to 84 percent vs. 75 percent statewide.

Table 2. MHS and Statewide Tenth Grade Math Scale Scores and Percent Passing Rates for 1998 - 2001

	Scale Score		Percent Passing	
Year	MHS	State	MHS	State
1998	220	222	47	48
1999	219	222	40	47
2000	229	228	62	55
2001	237	237	84	75

Note. Passing score is 220.

Figure 2. MHS and Statewide Tenth Grade Math Scale Scores and Percent Passing Rates for 1998 - 2001



That Mashpee's 2001 passing rate outpaced the state (84 percent vs. 75 percent) given identical scale score averages (M = 237), warrants closer inspection. As Table 3[9] shows, after lagging behind the state average in 1999 (40 percent vs. 46 percent), the percent of Mashpee students who passed the MCAS exceeded the state in 2000 and 2001. In other words, a greater percentage of failing MHS students improved to a passing grade (or better) in 2000 and 2001 than students in the rest of the state. This may seem counterintuitive at first, but is actually consistent with the earlier finding where at-risk MHS student outperformed other (higher ability) MHS students on the 2001 MCAS at least. Further, it is consistent with Mashpee's stated goal. Mashpee focused its efforts on its failing students rather than on students expected to pass the MCAS exam. This group of higher ability students did in fact pass the MCAS and even improved their scores, but were outperformed by their high ability peers in the rest of the state.

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[9] Note that Table 3 includes a category for the percent of student who failed. The number of students who passed is the sum of the Advanced, Proficient, and Needs Improvement categories.

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As Table 3 shows, for example, MHS lagged behind the state averages for percent of students in the *Advanced* category (13 percent vs. 18 percent). The more consistent increase in MCAS scores for students of all ability levels might indicate that other high schools implemented a remediation strategy that addressed all students rather than the targeted approach at Mashpee.

In sum, what appears to have happened is that MHS students converged closer to the mean (low ability student scores improved more dramatically than high ability student scores), while statewide, students of all abilities improved in a more consistent manner. The upshot is that a greater number of MHS students passed the MCAS (84 percent) than students in the rest of the state (75 percent). One could reasonably speculate that if the higher ability students at MHS had the benefit of the PLATO-supported course then their gain score would have been closer to the magnitude of the at-risk students and that overall, MHS would have outpaced the rest of the state in 2001. Conversely, if the lower-ability students did not have the benefit of the PLATO curriculum then MHS would have likely lagged behind the state averages.

Table 3. MCAS and Statewide Tenth Grade Math Scale Percent of Students by Student Performance Categories for 1999 - 2001

	1999		2000		2001	
Performance Category	MHS	State	MHS	State	MHS	State
Advanced (Scale Score 260 - 280)	6	9	14	15	13	18
Proficient (240 – 260)	11	15	16	18	32	27
Needs Improvement (220- 240)	23	23	32	22	38	30
Warning/Failing (200 – 220)	60	53	38	45	16	25

Thirteen of the 87 students who were enrolled in the PLATO remediation course (and six students of the 39 who were not), failed the May 2001 MCAS. As of November 2002, only three of these 13 students (who are currently seniors) have yet to pass the math portion of the MCAS, and all three have been identified as special needs students.

PLATO Data

To assess the possible contribution of PLATO and the MCAS course to student success on the MCAS exam, student PLATO performance, defined as the number of modules mastered, was correlated to the Spring 2001 MCAS scale scores. As mentioned, all 87 students in the remediation course were assigned to work on the same 34-module PLATO curriculum, which was aligned to both the state standards and the MCAS exam. Students mastered an average of 23.8 of the 34 possible modules. A significant correlation was identified ($r = .53$, $p < .001$, $n = 13$) between the MCAS scores and the PLATO usage data. In other words, student mastery of the PLATO modules was related to higher MCAS scores on the May, 2001 exam.

Interviews

Mr. Rob Miceli, PLATO Teacher-Coordinator. Mr. Miceli is a certified teacher with an endorsement in special education. It was the special education department at MHS in fact, that first started using PLATO. Mr. Miceli explained, "I saw its (PLATO's) potential and when Mr. Brown was looking to adopt PLATO on a bigger scale (for MCAS remediation) I volunteered to be part of it. I just saw tremendous potential to help under-performing students.

In describing the 34-module PLATO curriculum, Mr. Miceli explained how it was designed. "We did not start out trying to align it exactly with the state framework. Rather, we customized the course (34 modules) based on our Math teachers' recommendations. And I leave one day a week to teach study skills. For example, students are required to bring agendas and show organizations skills." He continued, "It is entirely self paced. Kids work independently – and they like that. They like that they are totally responsible for their work and grade."

Students working independently allowed Mr. Miceli to work with the students who are in most need, which is a major benefit, although in the beginning, it was very difficult to manage.

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"I would ask questions but then 5 - 6 kids' hands would shoot up right away – and stay up. They all needed help at once. To help me help these kids, I recruited a few community volunteers to help me. They (volunteers) would sit with the 'high maintenance' students the whole class, which really helped a lot. But then after a while, we stopped needing the extra help and didn't need the volunteers any more. I also use the advanced kids to help others. It is really great – you see kids helping each other all over the place."

In terms of classroom management, Mr. Miceli stresses flexibility. "You have to let them talk and interact a little. That's the only way many of them will learn – they need to move around a little and talk. I allow about five minutes at the beginning of class for some socializing and getting settled down, and five minutes at the end to get organized and pack up. That leaves about 30 – 35 minutes for focused work on the computer, which is about all these kids can stand at once. It works really well."

Mr. Miceli believes that PLATO has made a big difference. "I have been here 16 years. The Math scores (prior to the PLATO strategy) were the lowest I've ever seen. Then after we tried PLATO, the passing rate went up. And from all the students who took the test, there are only 3 left who have yet to pass it – and they are all special needs. One girl – a particularly tough case – asked me 'Can I do it after school this year?' I'd reminded her that last year (pre-PLATO), you did not want it (to work hard), you never showed up. Are you sure you want to? She answered that yes she 'really wanted to.' And she did."

Discussion

Mashpee High School administrators accomplished their goal of improving its passing rate for the tenth grade Math MCAS test. Without question, the PLATO-supported targeted strategy, along with the other instructional strategies designed by the MHS faculty and Mr. Miceli, were quite effective, improving the passing rate from 62% in 1999 – 2000 to 84 percent in 2000 - 2001. The dramatic improvement among at-risk students is particularly encouraging. PLATO's role in the overall strategy was significant as its use correlated with higher MCAS scores.

Surely, Mashpee's dramatic two-year improvement from 1999 – 2001 is encouraging. But the fact that it was accompanied by a similar increase statewide is reason to pause. The state improvement is surely due, in part, to a concerted statewide response among all high schools to meet the challenge of the MCAS graduation requirement. But it could also be true that the exam was easier in 2000 and 2001 than it had been in 1999 (although I have no basis for such a claim other than widespread improvement and the political pressure of having over half of the state's high school students failing in 1999). The most plausible explanation in my opinion is that the statewide improvement is best explained by a combination of better instructional strategies across the state, like those developed at Mashpee, and an easing in the difficulty of the test.

The fact that Mashpee's most challenged students performed so well is a tribute to the PLATO-supported treatment described in this report. That higher ability students, who did not benefit from the PLATO treatment, did not score as well relative to their peers around the state is testament to that. But that is probably a cost that is well worth incurring because it is much more important to raise student from failing to passing than it is to move students from *Proficient* to *Advanced*. The reward is certainly much greater for the failing at-risk students than the high

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ability students. One could even argue that forcing high-ability students to review for a competency test they expect to pass simply to raise the overall school average and improve the state ranking is unethical. In lieu of the skills-based review course, the high ability MHS students likely engaged in more advanced courses which will better serve them as they complete their high school and college careers.

From Mr. Miceli's comments, it is clear that improved student self esteem was an important benefit from the remediation program. Providing at-risk students with the time and tools to succeed provides an opportunity that could potentially help them turn a corner in their academic lives. Isolating PLATO's role in the strategy is difficult. It is impossible to know exactly how much of the MHS students success was attributable to PLATO and how much was attributable to the other strategies aimed at improving test scores. But as Mashpee used PLATO in very focused and consistent manner, makes it possible to argue that PLATO use was a significant reason for the MCAS improvement. The fact that student success in PLATO was related to passing test scores suggests as much. The encouraging fact is that the combination of PLATO and the efforts of skillful and dedicated teachers *together* made a difference with a group of students who are the toughest to reach and among the most disenfranchised in the system.

Recommendations

The Mashpee HS model seems to work extremely well. Whether this model can be replicated depends on several factors. It may be instructive to relate this implementation to the success factors identified by Rob Foshay in *Technical Paper #6* to both confirm and inform those recommendations. Critical success factors at Mashpee are in fact, consistent with Foshay's list. For example, the aligning of the curriculum to the MCAS (and state standards) is something Foshay sees as critical. The ability for Mashpee students to self-pace and work toward mastery in their own program is also advocated by Foshay. Also, that students worked for regular periods over an extended period is shared by Foshay, who advocates 'sufficient and frequent time on task.' And finally, strong leadership with clear objectives is a factor seen as critical by both.

Foshay also identifies in Technology Paper #5 eight steps that are necessary for a successful PLATO implementation. Following is a list of those steps and a brief discussion of what Mashpee unknowingly did to accomplish them:

Step 1: Get Buy-In from Key Personnel. At Mashpee, the instructional decision to adopt PLATO was made by the key personnel, which is probably the best possible buy in.

Step 2: Decide on Program Goals. The goal (to increase the MCAS passing rate) Mashpee was extremely well defined.

Step 3: Decide on the Instructional Applications of Technology. From among the three uses of software - supplementary, complementary, and primary – Mashpee used both to supplement and to complement the curriculum. PLATO was used to be the primary teaching vehicle (tutorial). But it was also used to complement instructor-led in-class instruction.

Step 4: Develop Instructional Models for Applications. Foshay describes four instructional models (review/reinforcement, enrichment, problem-centered, and skill development) any one of

which are valid approaches. Mashpee used PLATO to develop skills and to a lesser degree, for review.

Step 5: Develop an Instructional Management Plan. Mashpee dedicated a full time faculty member, Rob Miceli, to manage the entire program.

Step 6: Plan Hardware/Software/Support Deployment.

Step 7: Plan Professional Development. Since Mashpee's focus was relatively narrow, the need for professional development for it faculty was not very great. If they expand the use of PLATO, however, this will become an increasing need.

Step 8: Plan Evaluation. Mr. Miceli kept extensive student records and evaluated the program's progress. This diagnostic approach was a major part of in the program's success.

In sum, Mashpee's implementation plan, with no previous knowledge of Foshay's eight steps, seemed to take actions very similar to those recommended, thus validating the usefulness of the model.

About the evaluator:

Robert D. Hannafin is an associate professor of Educational Technology at the College of William and Mary, where he teaches preservice teachers at the graduate and undergraduate levels. He earned a Ph. D. in Learning and Instructional Technology from Arizona State University in 1994. His research interest is identifying features that predict success in computer-supported open-ended learning environments. He has published in numerous educational research journals including the Journal of Educational Psychology, Educational Technology Research and Development, and the Journal of Educational Research. Hannafin served on the board of Educational Technology Research and Development. He currently evaluates several U. S. Department of Education and NASA projects.

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